

Dec. 17, 1957

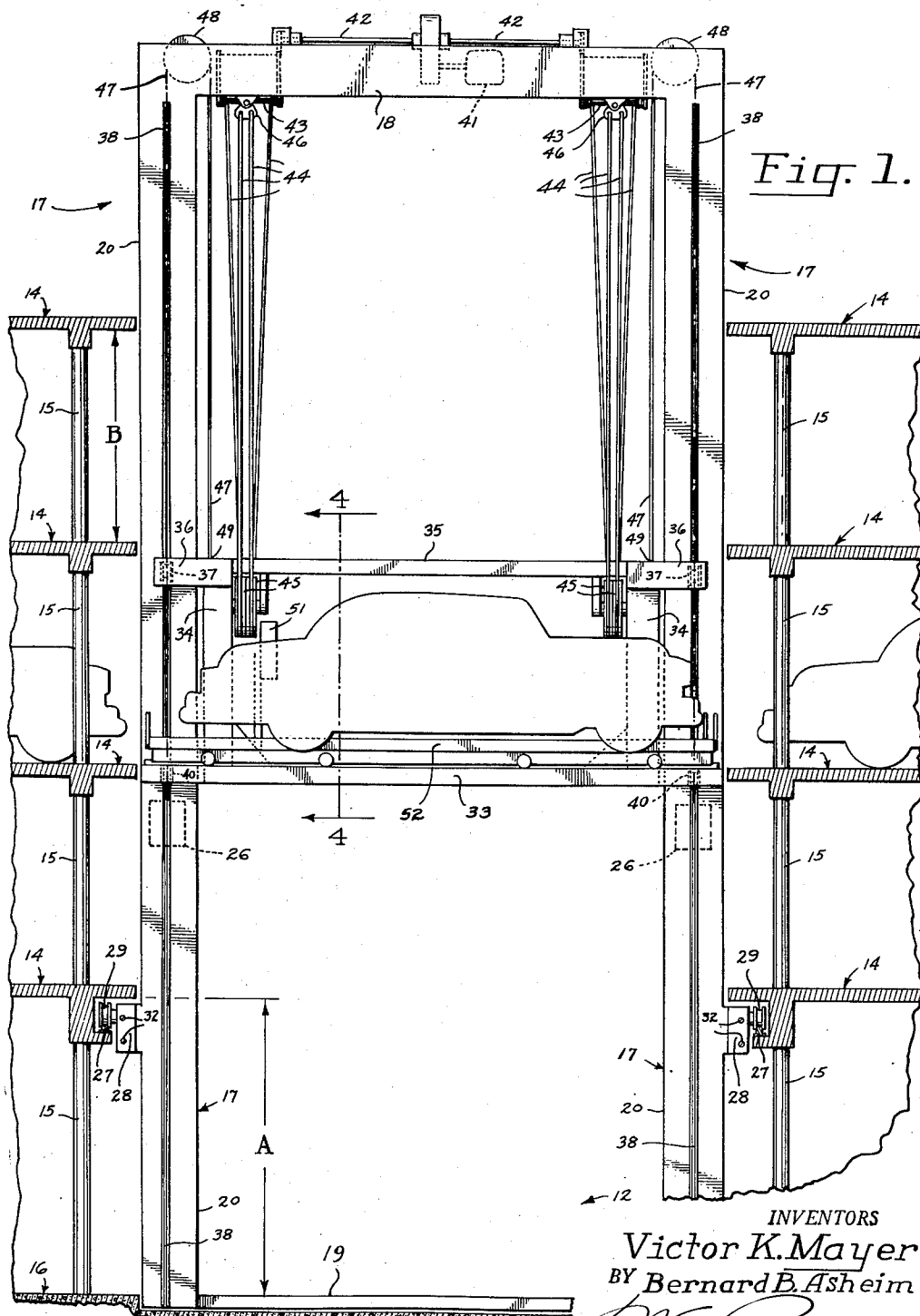
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2,816,624

ELEVATOR FOR MECHANICAL PARKING

Filed July 13, 1954

3 Sheets-Sheet 1



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Fig. 2.

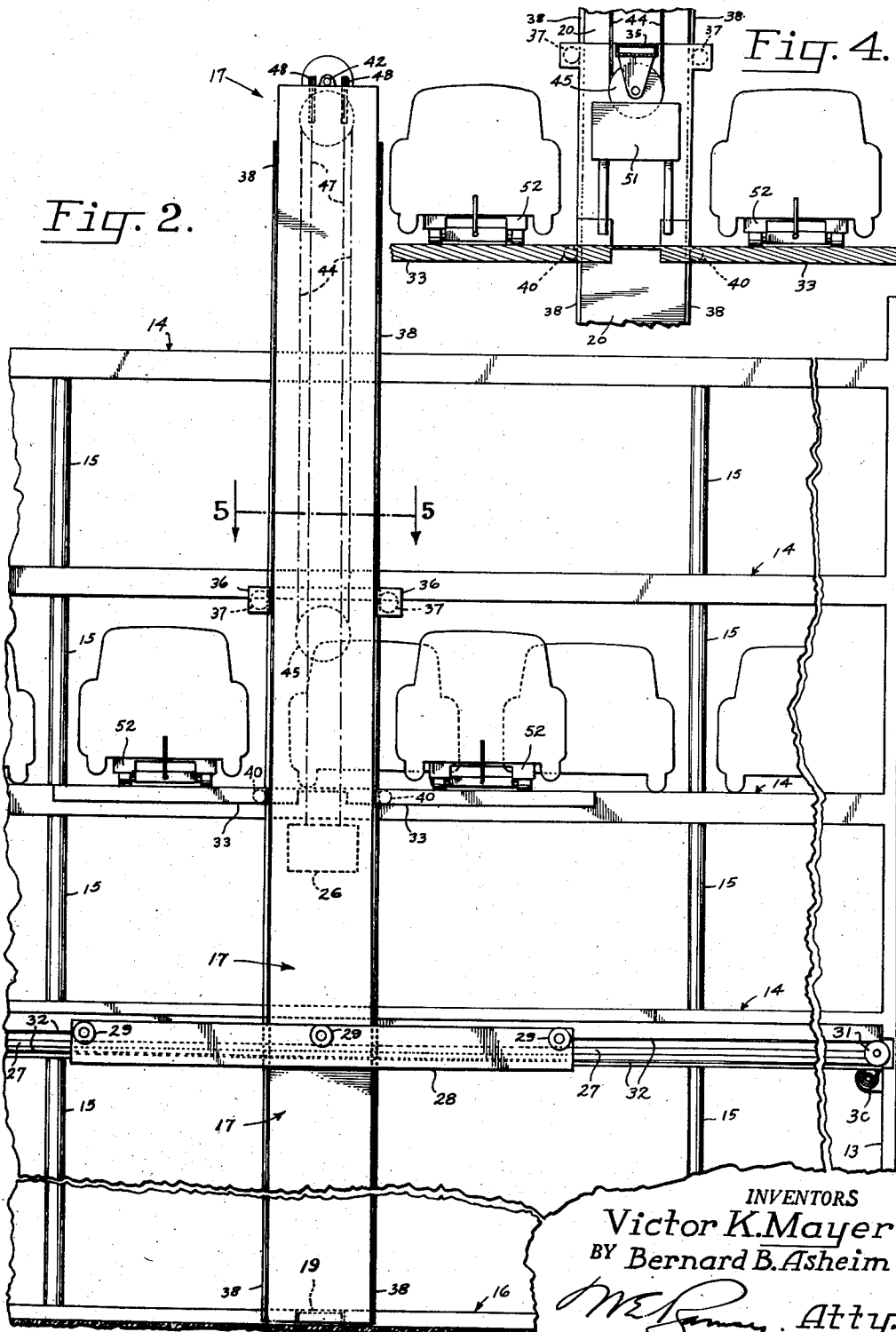
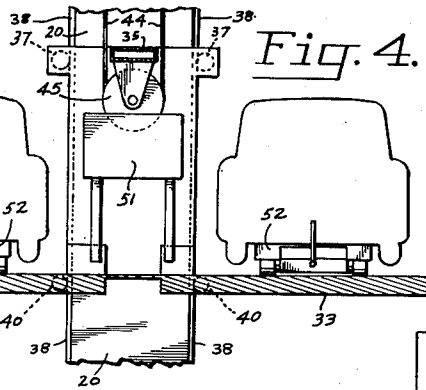


Fig. 4.



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3 Sheets-Sheet 3

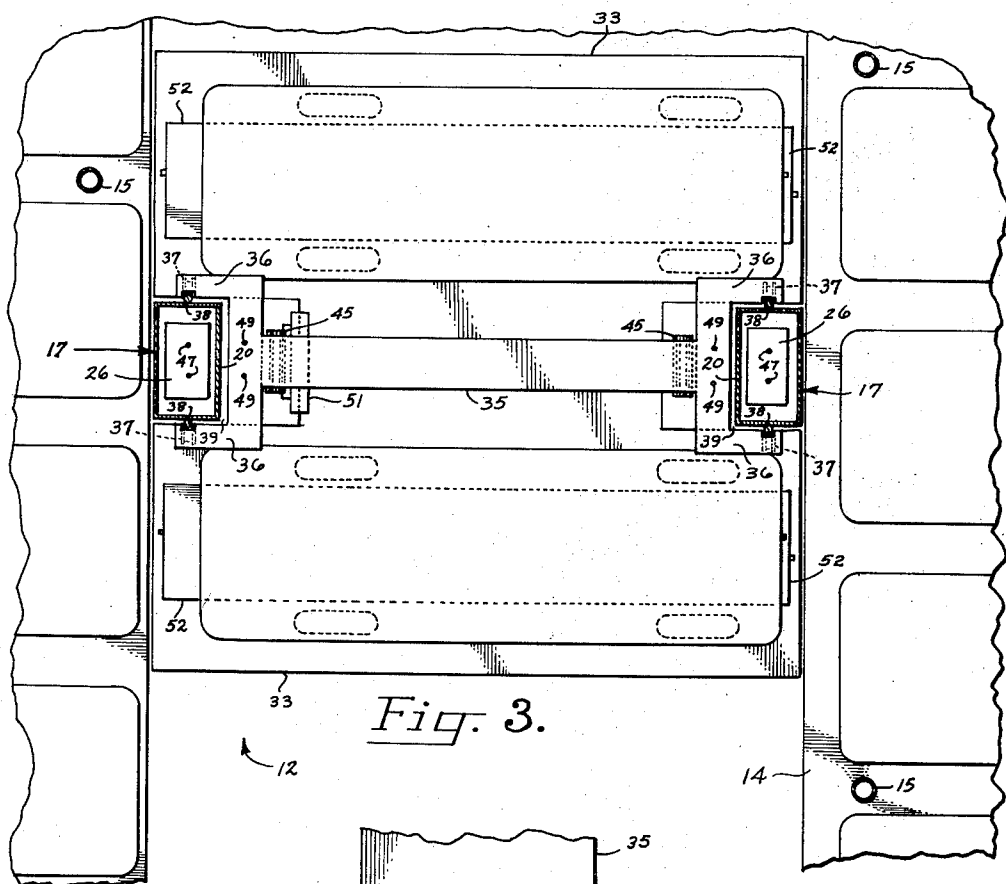


Fig. 3.

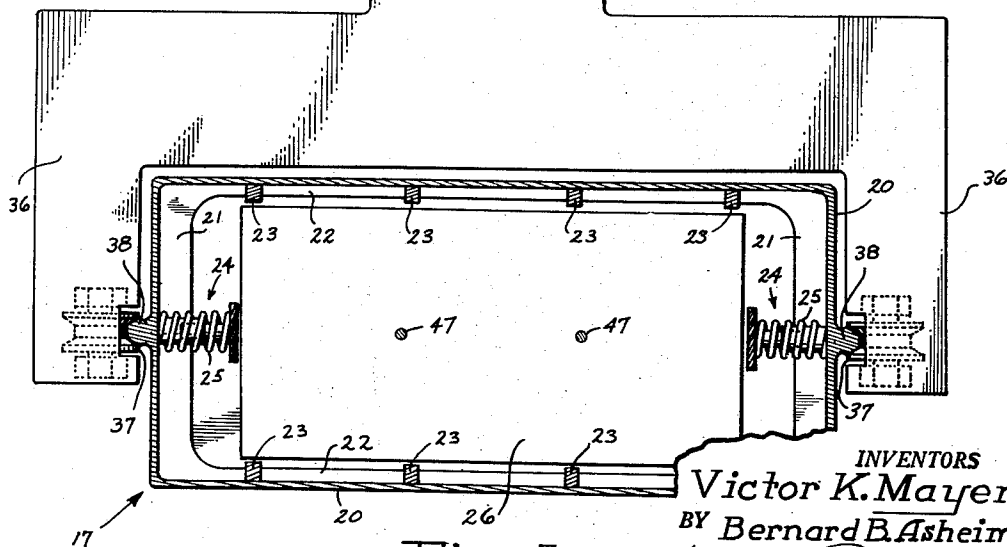


Fig. 5.

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ELEVATOR FOR MECHANICAL PARKING

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Application July 13, 1954, Serial No. 442,954

7 Claims. (Cl. 187—9)

The instant invention is one of several related inventions concerned with the various mechanisms and constructions employed in a multistory mechanical parking structure or building (see, in this connection, the co-pending common assignee applications entitled and numbered Modular Parking, Serial No. 444,755, and now abandoned; Stagger Stall Parking, Serial No. 442,952; Hydraulic Piston Parking Dolly, Serial No. 448,621; and Self-Propelled Mechanical Parking Dolly, Serial No. 442,953).

In particular, this invention is concerned with a gantry crane which carries a cantilever elevator of symmetrical design for moving pairs of automobiles to and from upper story parking stalls within a mechanical parking building, one object being to provide cooperative crane and elevator structures capable of realizing a maximum utilization of the building and consequently capable of generating a maximum financial return from the available space furnished by a given metropolitan land area.

In a mechanical parking structure of the type to which our invention pertains, there is provided a multistory building, usually of skeletal construction, in which a gantry crane and elevator move laterally and vertically, respectively, to service the various stories of the building in the parking of automobiles. Conventionally, the elevator carries a dolly upon which an automobile rides to and from a parking space. With our invention, a cantilever type elevator is provided whereby two parallel dollies are accommodated outboard of a single central elevator support. In function, the dollies move longitudinally off of and onto either end of the elevator while picking up and delivering automobiles so as to provide dual service throughout the building.

A mechanical parking structure contrasts with the more conventional ramp-type parking garage in that the former does not utilize drive-up ramps. Instead, the ground floor of the building accommodates an entrance and an exit, the upper stories define parking stalls, and a gantry crane and elevator moves the automobiles between the ground floor and the upper stories. A sequential operation begins when a motorist drives into and leaves his automobile parked in an entrance way on the ground floor. When our novel structures are employed, the motorist can lock the doors and set the brakes of the automobile so as to prevent tampering or theft. Thereafter, one of a pair of carrier dollies moves from the elevator under and between the wheels of the automobile to raise the latter clear of the floor. The dolly and automobile then are moved, as a unit, aboard the elevator for travel laterally and vertically to a vacant one of tandem-type parking stalls in one of the upper stories.

Upon arrival adjacent a vacant stall, the dolly travels out from the elevator, deposits the automobile, and returns to the elevator. In conjunction with such a typical operation, it is one object of the instant invention to provide an improved cantilever-type elevator structure which is symmetrical in construction and which is mounted upon

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an improved laterally movable gantry crane such that substantially the entire area of the building can be serviced by one elevator, and, at the option of the building owner, such that a majority of the ground level space can be utilized for purposes other than parking. For example, a typical building in which our novel elevator and gantry crane are installed, can provide retail shop or store space on the ground level and parking space thereabove. Such a provision is of immediate interest to land owners and merchants since the conventional mechanical parking structure is unsuited to the utilization of the ground floor for other than parking or entrance and exit structure yet a financially successful mechanical garage requires the income which retail shop rent can provide.

As will be appreciated by those skilled in the mechanical parking art, inventions upon which this art is based are concerned with a solution to the problems raised by the lack of adequate off-street parking facilities in large metropolitan areas. Congestion at the heart of cities both in America and abroad today is one of the most pressing problems facing city planners and management personnel. In the past ten years, the number of private automobiles on the streets of the United States has increased more than 65%. Because of this increase, off-street parking facilities have become relatively more scarce. Thus, increasing numbers of inventive suggestions have been aimed toward the provision of a satisfactory mechanical parking structure. In surveying these suggestions and in comparing the same to mechanical parking structures now in existence, however, one immediately is impressed with the lack of commercial acceptance found for the majority of mechanical parking inventions. This lack of commercial acceptance we have traced to a lack of practicality which is cured by our mechanical parking structure in that our inventive structure is less expensive to erect, less complex, faster to operate, and higher in the production of income. In total, the absence of the above factors will price mechanical parking off the market since the owner of a high price metropolitan land area can receive greater returns by employing his land for purposes other than parking. Accordingly, it is a prime object of the instant invention to provide improved elevator and gantry crane structure for a simplified mechanical parking facility and for one which is both speed and simple in operation as well as one which is capable of producing increased revenue through rental of the ground floor areas to retail shops or stores.

In this connection, it is our observation that the answer to the high lease cost of land for downtown parking garages is to be found (a) in the reservation of ground level or street floor space for retail sales use and (b) in the obtaining of sufficient income from the generation of retail subrentals to cover most or all of the operator's lease cost for the entire area occupied by his parking structure. Several factors, however, are of importance. Firstly, it must be realized that the more valuable the land area, the higher the retail rental income will be for use of the ground floor. This factor favors our invention over those parking facilities having no retail rentals. Secondly, the provision of first-class retail stores on the ground floor under a mechanical parking structure maintains and improves the character of a given shopping district. This is in direct contrast with a garage or parking lot having no retail stores along the street, the latter type of facility quite obviously serving to interrupt the shopping continuity and to leave a dead spot unfavorable to the surrounding stores in the area. Thirdly, it is a rule of thumb for landlords that the ground rent burden of a metropolitan land area should be carried by ground

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floor tenants. This rule of thumb already is applied to hotels, office buildings and many other metropolitan land uses and it can be applied to our invention as well. Lastly, mechanical parking structures which are erected for \$1,200.00 per parking space can be amortized in 25 years at 5% interest by a constant income of \$7.02 per parking space per month. Such a \$1,200.00 figure today is understood to be the break-even point in the construction cost of a mechanical parking facility. With our inventive structure, a mechanical parking facility can be erected at a cost of less than \$1,200.00 per stall and with the ground rent largely paid by the retail development of the ground level space. In total, our inventive structure thus provides one of the most profitable means by which private enterprise can redevelop large areas in the heart of metropolitan business districts in alleviation of the off-street parking problems.

One object of the instant invention is to provide a multistory mechanical parking structure with a gantry crane which is movable laterally of the building on tracks supported above the lower floor or ground level yet below the roof or topmost story of the building. With this provision, the structural complexity and resultant cost of the gantry crane can be minimized, consistent with structure safety requirements, and a maximum area of the ground floor of the structure can be utilized for retail shop or store rental.

One object of our invention is to provide, for a multistory parking facility, an elevator which is supported centrally only and which carries two lifting stalls cantilevered out from said central support to the end that the stalls can be positioned flush with the end members of the building for a full utilization of the end parking stalls and a resultant higher income to the operator.

Another object of our invention is to provide a gantry crane for a mechanical parking structure, which gantry crane carries twin towers of hollow box-like girder construction. In function, these hollow girders guide and are straddled by a vertically movable elevator and the hollow interior thereof serve to carry counterweights employed to counterbalance the operational movements of the elevator. This type of novel gantry crane construction is simple and inexpensive to fabricate yet is strong, durable and dependable as required by the use to which it is put in a mechanical parking facility.

A further object of our invention is to provide a symmetrical automobile elevator which is supported centrally of two integral cantilevered stalls in each of which an automobile dolly is carried so as to provide dual service throughout a mechanical parking structure.

The above and other advantages, objects and capabilities inherent in and encompassed by our invention will become apparent from the ensuing description, taken in conjunction with the accompanying drawings, a majority of which are partial views of a structure of recurring symmetry and wherein:

Fig. 1 is a side view of a portion of a complete multistory mechanical parking structure showing the gantry crane and elevator which service the structure, an automobile being shown in place on the elevator and several automobiles being shown in the parking stalls which occupy the upper stories of the structure;

Fig. 2 is an end view looking across the elevator well of a portion of a multistory mechanical parking structure in accordance with our invention and showing the gantry crane, the tracks, the dollies, the elevator, and other mechanisms associated therewith;

Fig. 3 is a plan view of a portion of a structure looking down upon the elevator well, gantry crane, and elevator mechanism of our invention and showing the hollow box-like girder construction of the towers which form the main columnar members for the gantry crane;

Fig. 4 is a partial detail section view, taken substantially on the line 4—4 of Fig. 1, showing the elevator and

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the manner in which this elevator is supported and guided for movement vertically on the twin vertical towers of the gantry crane; and

Fig. 5 is an enlarged detail view, taken substantially on the line 5—5 of Fig. 2, showing the hollow box-like girders of the gantry crane, together with the noncircular guides carried thereby for cooperation with sheaves carried by the elevator.

In each of the first three figures of the drawings, there is illustrated a portion of a multistory mechanical parking facility having two elongated parallel wings spaced by and arranged on either side of an open elevator well 12. The structural details of the building itself are not essential to an adequate understanding of the instant invention and therefore will not be described. We have, however, illustrated a preferred skeletal-type multistory structure in which construction costs have been maintained at a minimum.

The wings of the illustrated building are joined by end members 13 which may be either complete walls or merely bare girders, and the various upper stories 14 are supported upon columns 15 over a lower or ground level floor 16. In accordance with one object of our invention and, as is described in detail in the co-pending applications, Modular Parking, Serial No. 444,755, and Stagger Stall Parking, Serial No. 442,952, the lower floor area of our inventive structure is reserved for an entrance way and an exit way and for occupancy by retail shops or stores, whereas the upper stories 14 are reserved for automobile parking.

To service the upper stories from the entrance and exit ways, a gantry crane, together with an associated vertically movable elevator, is provided. It is this gantry crane and elevator structure which form the subject matter of the instant invention and now will be described in detail.

Referring to Figs. 1 and 2, the gantry crane is constructed with twin vertical towers 17 which are joined top and bottom by lateral tower support members 18 and 19, respectively. As shown in Fig. 5, each of the vertical towers most economically takes the form of a hollow box-like columnar member 20, the interior of which may be reinforced with webs 21 and 22 if additional strength is desired. The provision of further structural strength in each of the members 20 can be effected by the use of vertical reinforcing ribs 23, these ribs being continuous and the webs 21 and 22 being spaced vertically up and down the length of each member. Additional structure within the hollow interior of each member 20 preferably includes a spacer shoe 24 having a compression spring 25, one of the spacer shoes being secured to each side of the member at spaced points up and down the vertical length thereof. In function, the spacer shoes 24, cushion 25, and the associated web and reinforcing structure serve to position and guide a counterweight 26, which rides up and down within the hollow member, as will be described in detail hereinafter.

As will be understood by those skilled in the mechanical parking art, it is the function of the gantry crane to carry the vertically movable elevator and itself to move longitudinally across the building structure. To this end, a horizontal track 27 extends longitudinally of the building along each side of the elevator well 12. If desired, these tracks can be provided top and bottom of the wheels associated therewith. In Fig. 1, it will be noted that the tracks 27 are arranged adjacent the ceiling line of the ground level or first floor 16 rather than at the bottom of the elevator well 12 as might be expected. This positioning of the track structure upon which the gantry crane moves above the lower story but below the top story of the mechanical parking building, and the cooperative positioning of the wheels 29 intermediate the top and bottom of each member 20, is an important feature of our invention. Firstly, this positioning raises the center of

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moment of the gantry crane structure and produces a tower-like structure which is better balanced for wind and earthquake loads, the resistance of lateral forces and the like. Secondly, were the tracks 27 located at the bottom of the elevator well, an excavation would be necessary to depress the tracks 27 below the ground level since the elevator must be allowed to descend to a position where the floor thereof is at an exact ground or lower floor level. Thirdly, only that portion of each of the towers of the gantry crane which is above the horizontal track must be designed to resist buckling forces. This design allows a more economical utilization of metal in the construction of the gantry crane. Fourthly, as is set forth in more detail in the co-pending application entitled Stagger Stall Parking, Serial No. 442,952, we prefer to construct the lower floor of our mechanical parking building with a greater ceiling height than the upper floors thereof so that retail shops can occupy the lower floor space. This differential in ceiling height is illustrated by the arrowed letters A and B in Fig. 1, the letter A representing the lower and the letter B the upper story ceiling heights. For example, the ceiling height of the lower floor may be ten or twelve feet, whereas the ceiling height of each of the upper floors may be but seven feet. A seven foot ceiling height is ample to clear the roof of a parked automobile yet a retail store or shop requires a ten to fourteen foot ceiling height. This differential in ceiling heights cooperates with the positioning of the wheels 29 and the tracks 27 in that the gantry crane still is permitted to traverse the entire length of the building through the upper stories while clearing the lower floor ceiling with its increased available space. Thus, the provision of a greater ceiling height on the first floor yields a sufficient space to support the horizontal tracks 27 in an out of the way location without interference with the remaining functions of the building and the elevator well. These latter features are claimed in the co-pending application, Stagger Stall Parking, Serial No. 442,952; and in the other related co-pending applications previously listed herein.

In cooperation with the horizontal tracks 27, each of the box-like members 20 of the gantry crane carries a horizontally disposed bottom support member 28 on which are journaled the aforementioned flanged wheels 29 for cooperation with the tracks. Additionally, each side of the end members or walls 13 mounts an electric drive motor 30 and a rotatable driving drum or winch 31 about which pulling cables 32 are reeved in definition of an actuation means for the gantry crane. Thus, each of the cables 32 is joined to the crane, as by attachment to one of the support members 28, so that actuation of the corresponding motor 30 and driving drum 31 will move the gantry crane along the tracks 27 in one direction. Similar motor, drum and cable structure is provided at each end of the elevator well operatively joined to each end of the crane, yielding a total of four such structures functioning to move the gantry crane as a unit, back and forth along the tracks 27.

The automobile carrying elevator of our invention includes a horizontal platform member 33 having vertical end supports 34 and an overhead elevator support beam 35. The beam 35 is bifurcated at both ends as shown at 36 in Figs. 3 and 5 and one of a first pair of noncircular sheave means 37 is carried by each of the bifurcated arms. These sheaves are journaled in the arms 36 for rotation relative thereto and they ride upon noncircular vertical guides 38 which protrude from and are fixed to the exterior surface of the box-like girders 20. In function, this structure serves as a central support for the elevator platform 33 and the noncircular sheaves and guide bars serve as one portion of a two-pair guide mechanism for the elevator during vertical movements. Additionally, the bifurcated support beam 35 straddles the towers of the gantry crane at each end and the noncircular construction of the sheaves and guides 37 and 38 resist movement of

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the elevator back and forth between the towers as well as longitudinally of the building across the towers.

Additional guiding structure for the elevator is provided within recesses 39 which are formed centrally in the platform 33 and are adapted to straddle the box-like towers 17 of the gantry crane. In function, these recesses 39 carry a second pair of journaled noncircular sheave means 40 for cooperation with the aforementioned guide bars or rails 38. In Fig. 2 of the drawings, it will be seen that the sheaves 37 and 40 coact with the guides 38 and with the towers 17 of the gantry crane at spaced points so as to guide the elevator and to resist rotation or other unwanted side motion thereof during operation. Generically, we term this structure a central support and guide means about which the elevator is symmetrical as shown in Fig. 4.

In actuation of the elevator, an electric motor 41 is mounted on the top support member 18 of the gantry crane (see Fig. 1) and operatively is geared to turn an elongated drive shaft 42. The drive shaft 42, in turn, is joined at each end to a winch or drum 43 such that rotation of the electric motor 41 will turn the winches 43 simultaneously in the same direction. Cables 44 depend from each of the drums 43 and are reeved over idler sheaves 45 rotatably carried by the elevator support beam 35 and associated mechanism. The free end of each cable 44 is joined to a triangular balance pivot 46 carried by the top support member 18 to equalize the cable tension during operation. Additionally, the previously mentioned counterweights 26 are joined to cables 47 reeved over journaled pulleys 48 and secured, as at 49, to the aforementioned elevator support beam 35. In function, operation of the electric motor 41 causes the drive shaft 42 to rotate the two drums 43 to raise or lower the elevator platform 33. As the elevator is raised or lowered, the counterweights 26 move up and down within the hollow interior of the box-like members 20 to counterbalance the operation of the elevator. Appropriate control mechanism or push buttons for operation of both the motor 41 and the motors 30 can be provided on a control panel 51 located either on the elevator platform 33 as shown or at a central point in the building, as will be understood by those skilled in the elevator control art.

Referring to the elevator proper, the platform 33 is of cantilever construction and both margins thereof extend out beyond the central support and guide means as best shown in Figs. 2 and 4. In function, each of the laterally extending portions of the platform 33 defines a lifting stall on which a movable dolly 52 rests with an automobile thereaboard as shown in Fig. 4. The structural details of each of the dollies 52 is unimportant to an understanding of the instant invention but will be found described in the co-pending application entitled Self-Propelled Mechanical Parking Dolly, Serial No. 442,953. Suffice to say, each of the carrier dollies 52 is movable across the elevator into and out of the parking stalls and the entrance and exit ways of the mechanical parking building, and each is equipped with a vertically movable platform for lifting automobiles. In addition, the elevator platform 33 has a level deck so that each of the wheeled dollies can roll thereacross and into the various parking stalls. Preferably, all such operations are controllable from the aforementioned control panel 51 or a central location within the building. In Figs. 2, 3 and 4, it will be seen that the dollies 52 and the lifting stalls occupied thereby protrude out from the central support structure of the elevator substantially the width of an automobile in order to provide two stalls on the elevator with which two automobiles can be moved simultaneously. This provision for side by side dual movement greatly speeds the parking within the mechanical parking building and is complementary to the provision of tandem-type parking stalls which we prefer to employ.

In operation, both the lower and the upper stories of a mechanical parking building are serviced by the gantry crane and elevator. The motorist normally will drive in through one of the entrance ways provided on the ground floor (the lower or roof deck in some structures) where he will park his automobile, set the brakes, and lock the automobile to prevent tampering or theft. Thereafter, one of the dollies 52 will leave the elevator platform 33 and move between the wheels and under the automobile. Raising or jack mechanism aboard the dolly then lifts the automobile clear of the floor of the entrance way and both the dolly and automobile return aboard the elevator as a unit. Because of the cantilever construction of the elevator, two dollies are provided and two automobiles thus can be loaded simultaneously or serially as described. Once the elevator is loaded, the motors 30 are actuated to move the gantry crane longitudinally through the building at the same time that the motor 40 is actuated to lift the elevator vertically on the twin towers of the gantry crane to a location adjacent a vacant parking stall in one of the upper stories of the structure. The vertical elevator movements, of course, are guided by the coaction of the noncircular guides 38 and the noncircular sheaves 37 and 40. At the vacant stall, the elevator and gantry crane are stopped, the dolly and automobile move as a unit into the stall, the automobile is lowered onto the floor in a parked position, and the dolly returns to the elevator. The return of a vehicle from a parking stall to an exit way, of course, requires the reverse of the above described sequence.

In summary, it will be seen that we have served our inventive objects by providing an improved cantilever-type elevator structure which is mounted upon a laterally movable gantry crane such that substantially the entire area of a mechanical parking structure can be serviced by one elevator and such that even the end stalls on each floor can be used to park automobiles. In combination with the inventions of the previously listed copending applications, the above provisions are of primary utility in the alleviation of off-street parking problems.

We claim:

1. In combination, a gantry crane means supported for movement upon horizontal tracks, said gantry crane having spaced twin vertical tower means extending below and above the level of said horizontal tracks, said tower means being joined top and bottom by structural support means, each of said tower means including a vertically disposed hollow box-like girder having protruding guide rails of noncircular cross section affixed to two opposite sides thereof and extending vertically therealong, elevator means movable vertically of said twin tower means the full length thereof, and vertically spaced pairs of sheave means of noncircular peripheral cross section mated with said noncircular guide rails and carried adjacent each side of said elevator to guide the same during vertical movement.

2. In combination, a gantry crane means supported for movement along tracks and having spaced twin vertical tower means joined for unitary movement by structural support means, each of said tower means including a vertically disposed hollow box-like girder, elevator means movable vertically of and supported centrally intermediate said twin tower means, said elevator means including a platform having two parallel lifting stalls cantilevered out from the respective sides of said central support, and counterweight means movable vertically within said box-like girders and operatively joined to said elevator to counterbalance the operation thereof, said counterweight means coacting within said box-like girders with internal cushion and shoe means for guiding the vertical movements of the counterweight.

3. A movement mechanism, comprising a pair of hollow parallel vertical towers of noncircular cross section joined by lateral tower support means, wheel means

mounted intermediate the top and bottom of each said tower to accommodate the movement of both towers as a unit, elevator means guided for movement vertically of said towers and including a central elevator support means located centrally of the elevator and defining the only support therefor, said elevator being symmetrical about said central support, said elevator central support, said elevator central support means including vertically spaced support members of noncircular cross section conforming to said tower cross section, said support members straddling said towers and carrying pairs of rotatable means arranged with one of each pair of the rotatable means located on each of two opposite sides of the corresponding vertical tower to guide said elevator during operation and counterweight means movable vertically within each said hollow tower and operatively joined to said elevator to counterbalance the operation thereof.

4. In combination with a movable gantry crane having spaced twin vertical towers carrying protruding guides of noncircular cross section which extend the height of the towers, a cantilever type elevator means straddling the adjacent portions of said towers and symmetrically arranged with respect to a plane including said towers, said elevator means including a horizontal platform member with two central recessed portions, central support and guide means joined to said elevator and operatively bearing upon said towers to guide the elevator during vertical movement, vertical column means interconnecting the ends of said platform adjacent said recessed portions with a single laterally extending elevator support beam, said elevator support beam having bifurcated ends straddling said towers and each carrying a first pair of sheave means one of which is operatively engaged with each of said guides, and a second pair of sheave means carried adjacent the margins of each of said platform recessed portions and operatively engaged one with each of said guides, said first and second sheave means being of noncircular peripheral cross section conforming to said noncircular guides and lying vertically one above the other.

5. In a mechanical parking structure, a movable gantry crane having spaced twin vertical towers joined at their upper ends by a laterally extending frame member and carrying protruding guide rails which extend the height of the towers, an elongated cantilever type elevator means straddling the adjacent portions of said towers and symmetrically arranged with respect to a plane including said towers, said elevator means including a flat horizontal platform member, said platform being recessed centrally at each lateral edge thereof with each recess straddling a corresponding one of said twin towers, vertical column means interconnecting the ends of said platform adjacent said recesses with a laterally extending elevator support beam which lies above and parallel the centerline of the platform, said elevator support beam having bifurcated ends straddling said towers and carrying a first pair of sheave means operatively peripherally engaged with said guide rails drive means carried by said tower frame member and operatively joined to said elevator support beam for raising and lowering said elevator, both side margins of said platform extending out beyond the vertical support structure of said gantry crane substantially the width of an automobile to define spaced lifting stalls, and both end margins of said platform extending out at least as far as the vertical support structure of said gantry crane to minimize the clearance between the parking structure and the end margins of the platform.

6. In combination with a movable gantry crane having twin vertical towers joined at their upper ends by a laterally extending frame member and carrying protruding guides which extend the height of the towers, a cantilever type elevator means straddling the adjacent portions of said towers and symmetrically arranged with respect to

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a plane including said towers, said elevator means including an elongated horizontal platform member having central support and guide means operatively bearing upon said towers to guide the elevator during vertical movement, said platform being recessed centrally at each lateral edge thereof with each recess straddling said gantry crane, said support and guide means including vertical column means interconnecting the ends of said platform adjacent said recesses with a laterally extending elevator support beam, said elevator support beam having bifurcated ends straddling said towers and carrying a first pair of sheave means operatively engaged with said guides, drive means carried by said tower frame member and operatively joined to said elevator support beam for raising and lowering said elevator, and a second pair of sheave means carried at the margins of each said platform recess and operatively engaged with said guides, said first and second sheave means being spaced and lying vertically one above the other, both side margins of said platform extending out beyond said central support and guide means substantially the width of an automobile to define spaced lifting stalls, said lifting stalls being cantilevered from the remainder of said elevator structure.

7. An elevator, comprising an elongated flat horizontal floor member recessed centrally to bound a straight sided recess at each end thereof, parallel vertical support means extending upwardly from the inner margin of each said recess, a horizontal beam member joining said support

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means above said floor member, each end of said beams being bifurcated at a point above a corresponding one of said floor recesses to define two arms which are spaced laterally substantially the same distance as the spacing of the straight lateral margins of the corresponding recess, and guide means facing inwardly of each said arm and each said recess straight lateral margin to guide the elevator during movement, both side margins of said floor member extending out beyond said vertical support means substantially the width of an automobile to define two lifting stalls, said lifting stalls being cantilevered from the remainder of the elevator structure.

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